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An Abstract of a Treatise of the Calculus Humanus in answer to several Queries proposed by Sir John Hofkins; by the Learned and Ingenious Fred. Slare M.D. and fellow of the Royal Society.

IT is generally observed by those that have been subject to the *Stone* of the *Bladder*, that pains in the *Kidnies* were antecedent, which intimates the foundation was first laid there, and afterwards by the *Ureters* and a *Gust* of *Urine* conveyed into the *Bladder*. The manner of its growth in the *Bladder* is obvious, the *Urine* (by some called *Lotium*) being too highly satiated or impregnated with a ponderous matter (which we here design to examine) precipitates the same at certain times upon the mention'd *Basis* and also on the inward *Superficies* or *Coat* of the *Bladder*, which upon a Relaxation of their distended *Fibræ*, do soe strictly embrace that præternatural substance it finds there, as to overlay it or cloath it with what ever Sediment subsided there. That the *Urine* only at some *Intervals* is disposed to let fall this matter, seems probable from this observation that the *Concrete* consists of several *Spherical Superficies*, or round Incrustations, which like so many distinct *Shells* may be parted from each other. Moreover these Incrustations are observed to be very unequal, some much thicker then the other : An argument that the *Urine* continued much longer disposed to depose this *Calculus*

lous matter at one time than at another : or else that it was much more satiated or abounded with this ponderous *Precipitate* at one time than at another, and so laid it over with thicker *Crust* in as short a time.

If we might be allowed briefly to examine the causes that have been assigned to the *Production* of this *Concrete* ; I think we cannot well grant *heat* in the *Kidneys* to be a probable efficient Cause ; a much more *Intense Heat* than is possible to be found here, being necessary to make *Bricks*, or bake *Sand* and *Earth* into *Stone*. Nor is it necessary to derive the material Cause from such a slimy and roapy or mucilaginous Indisposition of the humours, that may perhaps coagulate and harden into a *Stone*. Such a *viscous Urine* being less apt to precipitate this gritty matter than more thin and limpid *Urine*. For I have found in more than one, where the *Urine* has often been so roapy and stringy that it would draw out into threads upon the application of a stick ; but yet we never discover'd symptoms of the *Stone* in the *Kidneys* or *Bladder* of such Persons. Nor do I believe that an *Acid* meeting with some *Alkalies* may be reasonably concluded to constitute this so firm and solid a *Concrete*. Which does not at all hold good in our *Analysis*, nor does it seem reasonable, that *Acids* should make this *Connection*, since nothing that I know of but *Acids* will make the least *Solution*. Now if *Acids* make the first *Bond* of *Union*, we may expect from them rather that they should strengthen and confirm than shatter this *Confederacy* in pieces.

Nor can I charge any putrifying morbid *Ferment* in the *Kidnies* with such a *Coagulating power* as will answer for the *Product*. This *Hypothesis* of *Helmont* being very precarious, and seems grounded on one uncertain Instance, of a Person that upon eating *Asparagus*, from
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that time contracted the *Stone* in the *Kidnies*, which Plant he much discommends as well as the *Raphani*, upon the score of their ill sent, for disposing the *Kidneys* to putrefaction, and so to breed the *Stone*. Much might be said to invalidate this *Hypothesis*: but the common and innocent use of these *Pl nts* will secure us against this prejudice, upon which *Observation* his *Hypothesis* seems wholly to depend.

We may also except against the Experiment of *Coagulation*, upon the mixtures of high rectified *Spirits* of *Urine* and *Wine*, which if warily managed will make a *Coagulum* with such expedition as seems very strange and surprizing: for this *Concretion* will easily be dissolved by water. In like manner if either of the *Spirits* be very *phlegmatic*, there will follow no *Coagulation*. In so much that the humours of the *human Body* contain too much *water* in them to admit such an Effect, even in those *Constitutions* that have used themselves to very highly rectified *Spirits*. Moreover *Horses* *Doggs* and other *Animals* that drink no *wine* are not free from this gretty *Cementation*. Nor could I ever discover any drop of *vinous Spirits* afforded upon our Distillation of this matter. I would not be thought here to excuse these *Ardent Spirits* from doing mischief to the *human body*, but doe believe that they are apt enough to make ill *Secretions* and some *Concretions* of the humors, (tho' of an other sort) I mean such as are visible enough in the *faces of Great drinkers* and the like. Nor is this disagreeable to our *experiments*, where tho' the diluted and weakened *Spirits* will not convene into a firm harden'd body, yet some lesser and softer *Concretions* will Subside to the bottom of the *Glass*.

We may also question the *Hypothesis* of the *Production* of the *Stone* by *Petrefaction*. Stones are such fixt bodys that they yield nothing upon *Distillation* except a small
Quantity

Quantity of insipid water chance to rise, nor will they *Exhale* very much in an open fire, whereas we can *volatilize* fix parts of eight of our *Calculous matter*: and obtaine *Salts* and *oyls*.

But to pass on: The *chymists*, who of all men suppose their *Opinions* the least subject to uncertainty, being grounded on *experiments*; They describe the *Concretions* of the body, and particularly this morbid one by calling them *Tartareous*: who conclude they have sufficiently accounted for the nature of a body, if they can but call it *Tartar*, which must be acknowledged to consist of *Acid*, and *sixt Salts*, called *Alcalizat*, and of some *Tarra damnata*; tho' it be very little in proportion to the other *Salts*.

If we compare such *Analyfes* of the *Calculus* which we have often made, with the aforesaid *Tartar*, we may then infer what little reason there is to *Eclipse* its nature by that denomination. We Distilled an ounce of *Calculus Humanus*, that was recently cutt out of a body, which afforded about two *drams* of a brown *Spirit*, nearer to that of *Harts-horn* than *Urine*. We put the *Caput mortuum* upon the *Cupel* and reduced it to near a *dram*, the rest burning and smoaking away.

Another time we distilled in a naked fire a *Stone* that weighed two ounces, the *Vapor* came over upon a good streis of fire, and settled in the form of *Salt* without any *liquor*, of which we preserved only a *dram*, it appeared very brown and tasted *bitter*, as the *fetid oil* of *Harts-horn* and other *Empyreumatical Oils* doe. We examined by boiling and evaporating water from the *Caput mortuum*, whether it held any *sixt Salt*, but found none. The *Caput mortuum* weighed one ounce and six drams, so that it lost only two drams in the *Distillation*; that is only two drams came over the *Helme*. We proceeded farther and placed this *Caput mortuum* upon a *Test* in an open fire, where

where it burnt away to two *Drams*, 44 *Grains*: this we also boyled in water to see what salt it held, it scarce afforded a tast of Salt, scarce surmounting that we usually find in the like Quantity of common water.

The *Chymists* do generally pass by one material Circumstance in their *fiery Tryal*: rarely enquiring after that considerable part evaporated in the open fire which in our present *Experiment* proves much the greater proportion of the Body. There being an ounce and three drams of our two ounces evaporated, of which we have no account, I endeavoured to save some of it, (tho I concluded it impossible to preserve very much) by placing a taper Chimney or Tunnel to receive the *Smoak* as the fire and a pair of Bellows raised it, which so far succeeded that I caught above two drams of this *fuliginous Substance*, and some drops of a water of a fetid saline Tast.

To make many experiments with this *Product* it requires a greater Quantity of water then *Lithotomists* will easily furnish us with. The *smoak* of our common fires gives us a *Sublimat*, whose *chymical Principles* are no less considerable than the bodys from whence they ascend. For I lately found them not only to contain *volatile Salts*, *Oyles*, and *Phlgm* with other things, but even a *Salt* so near to common *Sea Salt* that it shot into *Cubic Figures*: much like to that we lately exhibited here in our *Analysis of Urine*. But seeing it was then objected that that *Salt* might probably be nothing else but the common *culinary Salt* we constantly take in with our *Food*, I have since distill'd the *Urine* of *Horses*, that were fed with Hay and Oates, and have obtained the same sort of *Salt*. Both of these *Experiments* confirm Dr. Grew's discovery of *marine Salt* in several *Plants*: which I am apt to think was *Antecedent* there, to its exposition in the open *Air*, for several reasons too large to be here mention'd: having been guilty of a small digression already.

If we now compare this concrete with *Tartar*, we find

the one a *vegetable Salt* wholly *dissolvable* in *water*: the other so stubborn, that several very corrosive *Menstruums*, that will easily dissolve *Iron* and *Copper* and *Silver* and almost any thing, will not make any Impression here. The one affords a little *volatile Salt*, which is *Alcalizat*, and no *fixt Salt*. The other gives no *volatile Salt*, and a very large proportion of *fixt*. The one affords much more *earthy Substance* call'd *Terra Damnata* than the *Hoofes* or *Horns* of *Animals*, &c. and the other leaves us scarce any. One abounds with an *acid Salt*, which is sensible to the palate, and very manifest in the *Spirit* of *Tartar*, but in the other we could discover none upon the narrowest search. This leads us to the *Examen* of *Tachenius* his *Experiment*: which is this.

He puts a whole *Stone* of the *Bladder* into a *Retort*, and distils over a liquor, which he acknowledges to be *urinous*; this done; he pours back the liquor upon the body from whence it was distill'd, which he says reduces this *Caput mortuum* after a short infusion to its former solidity. From whence he concludes some *occult Acid* mixt with this *Alkali*, must needs cause the hardening so friable a body, which, without it, will be apt to crumble into dust like the *Subterranean Carcases* of *Rome*, that molder away upon the least touch.

A great fondness for the *Hypothesis*; made the *Operator* very careless in his Examination. For the *Caput mortuum* he supposes so very pulverisable, I could never find so, but after *Distillation* it remained almost as hard as formerly, and this is certain that upon the Reaffusion of the *Spirit*, it grew rather softer than harder. But if we reflect upon what has been said and experimented before, it will prove unnecessary to argue further against *Tachenius*. Hence we may infer that 'tis very dangerous to give the same *names* to things that are very opposite in their *Natures*: by this means men are very apt to be led into Errors. Thus the notion of presuming this mat-
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ter *Tartareous*, has put men upon using *Medicines* to destroy *tartareous Concretions*, as well as avoid many things that seem to have *Tartar* in them: and yet at the same time perhaps it may be as inoffensive as some of those *Medicines* that are substituted; at least, as *Spirit of Salt* or common *Salt* commended by *Helmont*. In the manner the notion of *Petrification* which seems, from whence the Stone derives its Name, may be no less erroneous, there being no agreement or *Analogy* in their *Nature's* whether we consider them *Synthetically* or *Analytically*. If we consider *Stones in composito*, there is a particular *Weight* or *Gravity* belonging to their *Bulk* in which they *specifically* agree. Several sorts I have weigh'd according to the *Hydrostatical Laws*, I find them agree in being twice as heavy as their Bulk of water, and about a fourth part more. This I found true in *Wood*, *Bone*, and *Shells*, when petrified, and even *water* it self, and some other *Bodies* tho never so light in their former state, as soon as they have obtained the form of *stone* they all become of the mention'd weight or very near it. But this which is called the *Stone* of the *Bladder* is much lighter, and several of them agree in being only as heavy as their Bulk of water and a 4th part more. This yields to none but the most potent *Acids* and particularly to *Nitrous* ones alone; the other is dissolved by almost any slight *Corrosive*. The one in our *Analysis* affords various constituent parts, and the other upon *Distillation* only a drop or two of insipid water, the rest remaining fixt. But we need not insist upon the difference which is so obvious.

Since 'tis much easier to quarrel at other's *Hypotheses* than to invent better, in order to the giving some account of the *Cause* of this *Nonnatural Concrete*, I would lay down some Considerations.

This *Concrete* may herhaps owe its *Origine* to a very soft and thin *fluid*; more remotely to the *chyle* strained through the *Guts*, and yet nearer the matter to the *Blood* it self, but

nearest and immediately to the *Serum* of the *Blood* which seems to be its proper *Vehicle*.

We shall be the less surpris'd to derive such firm and solid *Productions* from *fluids*, when we consider that there are particles floating in the *Blood* always disposed to be converted either into *Gristles*, or to make up the solid *Skull*, *Nails*, *Bones*, &c. and that even the *Teeth* whose *Texture* is very firm, are made and supplied out of the soft *fluids* of the *Body*.

Even some of these solid parts of the *Body* may by a *Disease* of the *Blood* be abraded and absorbed by the common *Fluid*, and *precipitated* by their own weight upon the *Pelvis*; or else stick in the *Tubules* of the *Kidnies*, and so choak them up, and by degrees extend them to a *Rupture*, or grind them to pieces by a constant impulse of this *gritty substance*, which may at last convert the greatest part of the *Kidnies* into this firm *Concrete*.

Moreover without any respect had to these solid abrasions, the *Blood* it self (of which the *Serum* is a great part and with which it is intimately mixt) consists of *heterogeneous Particles*, of so various forms, sizes and shapes, which seems necessary for their accommodating themselves to all *parts*, that even these design'd to constitute the solid parts, may suffer such irregular changes in the *Body*, which may unfit them to pass the *emulgent Vein*, and so to continue their *Circulation*. In so much that the continued *Impulse* of this matter by the *Artery* may make very considerable *Aggregates* or *Concretions* in the *Kidneys*.

And not only so but without either respect to *Vein* or *Artery*, the *serous* or watery part of the *Blood*, which we said before was the *Vehicle* of the *Stone*, may have imbibed such heterogeneous gross and ponderous *Particles*, as may whilst in *circulation*, fluctuate and mix well enough together, but may very easily separate upon the least *Stagnation*. Thus *Water* and *Oyl* unite only by *contact*, and
that

that by a violent Concussion and agitation of their parts, which as soon part as the force is ta'en off. The various mixtures in a *Torrent* seem to make up one homogeneous *Fluid*, but if some part of this Fluid happen to fall into a Pit, or stagnate in a quiet place, we shall find it clear it self of *Sand*, *Mud* and other differing parts. So great a difference there is betwixt the *humors* during their motion and agitation through *Veins* and *Arteries*, and when they are in the quiet Passages of the *Kidneys*, or the more quiet state in the *Bladder*; as there is betwixt a *Torrent* and a *Well*: the first may hurry along with it such gross and ponderous parts, which easily subside in the other.

That the Nature of this Concrete seems rather referable to *Bone* than to any other consistent or fluid part of the Body, I concluded by comparing *chymical* Products which I only very briefly relate.

Having cleared the *Bone* of *Marrow* and *Fat* by boiling it in water, I distilled it and obtained about two drams and an half from an ounce of *Bone* of a volatile liquor impregnated with *Salt*, that smelt very much like that I have mention'd, which was very differing from Spirit of *Urine*; and nearer that of *Harts-horn*: I found the *caput mortuum*, as to weight, very consonant; and also could extract no manner of *salt* from it. For which reason *Refiners* make their *Cupels* of *calcined Bones*, they being forced to dulcify (which they call washing out the *salts* of) other *Asses* before they can make *Cupels* of them. Last of all it herein also agrees with the *calculus Humanus*, vulgarly so termed, that few *Acids* will dissolve it, excepting those that are *nitrous*, nor do these work on it very vigorously.

Herein they must be al'ow'd to differ in their *specific Gravity*, the *Calculus* not having so close and compact a Texture as the *Bones* have. For *Bones* I have found twice as heavy as their Bulk of water.

*An Index of some Experiments made in this
short Treatise.*

Several Stones of the *Bladder* and *Kidnies* were distill'd, all afforded *volatile urinous Salts*; which Ferment upon any *Acids*. *Bones* were distill'd and found to be of agreeable *Principles*.

Petrified Water affords only fresh and clear water upon distillation.

Calculi examined *Hydrostatically*, were found in proportion to their Bulk of water as 5 to 4.

We weigh'd *Flint*, *Crystal*, *petrified Water*, *Welch Diamonds*, *petrified Wood* in water, and found them all very near of a *specific Gravity* and almost as heavy again as our *calculous* matter.

We weigh'd *Bones Hydrostatically* and found them twice as heavy as their Bulk of water.

Bones not easily wrought on by common *Acids*, only by *nitrous* ones and that without *Ebullition*.

Various unsuccessful attempts made to dissolve the *Calculus*, by *acid* and *Acrimonious Menstruums*, some were *Vegetable* and some *Mineral*, as *Spirit of Salt*, of *Vinegar*, of *Venus*, *Oyl of Vitriol*, &c. also with *Alkalifat acria*, as *Sal Fraxini* (which corrodes *Glass*) *Lapis Infernali*, but none would touch it except *nitrous*.

The *Coagulation of Spirit of Wine* has no place here

Experiments to be made Relating to the Therapeutic Part.

TO discover innocent *Menstruums* that may dissolve the *Stone*.

To examine the Condition of the *Urine* sometimes before a *Paroxysm* both as to its *specific Gravity* and *Contents*.

And also during the *Paroxysm* to regard the painful water sometimes transmitted.

To enquire into the *Nature* of *nephritic Medicines*.

To examine *Lythonthripticks*, so as to exclude those from that *Class* and *Character*, which have no relative Vertue that way : and to lessen the *Catalogue* of those mistaken *specifics*.

To enquire into the *Nature* of the *Hop*, which is so much and perhaps innocently condemned for its aptness to generate the *Stone*.

To explain the manner of the *Operations* of some *Medicines*, which tho they are not *Lythonthripticks* yet may be good *Nephriticks*.